DOCUMENT RESUME

ED 335 238 SE 052 417

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TITLE Communicating the Next Message of Reform through the Professional Standards for Teaching Mathematics. ERIC/SMEAC Mathematics Education Digest.
INSTITUTION ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO EDO-SE-91-6
PUB DATE 91
CONTRACT RI88062006
NOTE 3p.
PUB TYPE Information Analyses - ERIC Clearinghouse Products (071)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Community Support; *Curriculum Development; *Educational Assessment; *Educational Improvement; Elementary School Mathematics; Elementary Secondary Education; Local Issues; Mathematics Curriculum; *Mathematics Education; *Mathematics Instruction; Mathematics Teachers; Preservice Teacher Education; Professional Development; Public Support; School Support; Secondary School Mathematics; Standards; Teacher Attitudes; Teacher Evaluation; Teacher Improvement; Teacher Role
IDENTIFIERS ERIC Digests; National Council of Teachers of Mathematics; *NCTM Curriculum and Evaluation Standards

ABSTRACT

The National Council of Teachers of Mathematics (NCTM), with the establishment and promulgation of standards for the reform of teaching and learning mathematics, has furnished the leadership and the impetus toward the achievement of a vision of affording a high-quality mathematics education for all of the nation's children. Published in March 1989, "Curriculum and Evaluation Standards for School Mathematics," along with a companion document, "Professional Standards for Teaching Mathematics" (NCTM, March 1991), have provided statements of what is valued in the school mathematics classroom. These statements have, in turn, promoted dialogue for the institution of reform on many fronts, including individual schools, local school districts, state boards of education, and universities. Incorporated in this digest are (1) a listing of the major shifts within the school mathematics classroom envisioned by these standards; (2) the two fundamental assumptions concerning teachers that underlie this new vision; (3) the specific beliefs and decisions of classroom teachers that can empower students by helping to encourage mathematical thinking, reasoning, and problem solving; (4) the assumptions that promote an evaluation of how and what information should be gathered and analyzed, by both teachers and administrators, to help teacher improve their teaching; (5) a listing of influences and expectations that are necessary for improved preservice and continuing education of mathematics teachers; and (6) the groups that must play a supportive role when making decisions that affect the teaching of mathematics. (JJK)

ED 338 838

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ERIC/SMEAC Mathematics Education Digest EDO-SE-91-6 No. 2, 1991

# Communicating the Next Message of Reform through the Professional Standards for Teaching Mathematics

To achieve the vision of a high-quality mathematics education for every child, the National Council of Teachers of Mathematics (NCTM) has provided leadership in the establishment of standards for the reform of teaching and learning mathematics. These statements of what is valued were communicated first in CURRICULUM AND EVALUATION STANDARDS FOR SCHOOL MATHEMATICS (NCTM), released in March, 1989. The companion document, PROFESSIONAL STANDARDS FOR TEACHING MATHEMATICS (NCTM), was presented in March, 1991. Together, these standards reflect NCTM's long-term commitment to the reform of school mathematics.

## What is the vision of teaching mathematics in the professional standards?

The teaching envisioned in the Professional Standards for Teaching Mathematics is significantly different from what many teachers themselves have experienced as students. Woven into the fabric of these standards are major shifts that will empower students:

•Shift toward classrooms as mathematical communities and away from classrooms as simply a collection of individuals;

•Shift toward logic and mathematical evidence as verification and away from the teacher as the sole authority for right answers;

•Shift toward mathematical reasoning and away from mere memorization of procedures;

•Shift toward conjecturing, inventing, and problem solving and away from merely emphasizing finding the correct answer;

•Shift toward connecting mathematics, its ideas, and its applications and away from mathematics as a body of isolated concepts.

## What are the fundamental assumptions that underlie the new vision?

Underlying the new vision are two fundamental assumptions:

•Teachers are the key to changing the way in which mathematics is taught and learned.

If teachers are to create learning environments that empower students, teachers need time and resources to develop the professional teaching skills envisioned here. They must have ongoing professional development opportunities, flexibility, and instructional and assessment materials that are consistent with the Curriculum and Evaluation Standards.

•Teachers must have long-term support and adequate resources.

This vision of teaching mathematics requires that teachers be supported, encouraged, and rewarded by administrators, parents, and the community. This kind of recognition and collective support will take time to develop, but it is a principal element in effective change in the classroom environment.

## Standards for Teaching Mathematics

All students possess the innate power to think and reason mathematically. The standards in this section address the specific decisions that teachers make in the classroom to foster mathematical thinking, reasoning, and problem solving. They are based on the following assumptions:

•The goal of teaching mathematics is to help all students develop mathematical power;

•WHAT students learn is fundamentally connected with HOW they learn it;

•All students can learn to think mathematically;

•Teaching is a complex practice and hence not reducible to recipes or prescriptions. The standards are organized around a framework emphasizing the important decisions that a teacher makes in teaching;

•Setting goals and selecting mathematicaltasks to help students achieve these goals;

•Stimulating and managing classroom discourse so that both students and teacher are clear about what is being learned;

•Creating an environment to support teaching and learning mathematics;

•Analyzing student learning, the mathematical tasks, and the environment in order to make ongoing instructional decisions.

## Standards for the Evaluation of the Teaching of Mathematics

These standards are intended to help teachers attain the vision of the Curriculum and Evaluation Standards by emphasizing the role that evaluation can play in teachers' professional development. Accordingly, these standards focus on how and what information should be gathered and analyzed to help teachers improve their teaching. The standards are based on four

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assumptions:

•The goal of evaluating the teaching of mathematics is to improve teaching and enhance professional growth;

•All teachers can improve their teaching of mathematics;

•What teachers learn from the evaluation process is related to how the evaluation is conducted;

•Because teaching is complex, the evaluation of teaching is complex.

The consistent theme is that the major purpose of evaluation is the improvement of teaching. The standards give guidance to teachers seeking self-improvement, to colleagues mentoring others, and to supervisors and others who are involved in the evaluation of teaching.

## Standards for the Professional Development of Teachers of Mathematics

These standards address the pre-service and continuing education of teachers of mathematics at the K-12 levels. They apply to introductory programs that prepare teachers of mathematics and various continuing education activities. They are based on the following assumptions:

•Teachers are influenced by the teaching they see and experience;

•Learning to teach is a process of integration;

•The education of teachers of mathematics is an ongoing process;

•There are level-specific needs in the education of teachers of mathematics.

These teaching standards provide essential guidance to colleges, universities, and schools; state departments and provincial ministries of education; public and private schools; and all who are part of the preparation and professional development of teachers. The standards address:

•Modeling good mathematics teaching,
•Knowing mathematics and school mathematics,
•Knowing students as learners of mathematics,
•Knowing mathematical pedagogy,
•Developing as a teacher of mathematics,
•Teachers' roles in professional development.

## Standards for the Support and Development of Mathematics Teachers and Teaching

These standards spell out the responsibilities of those who make decisions that affect teaching mathematics. The environment in which teachers teach is as important to their success as the environment in which students learn is to theirs. The standards identify the groups that must play a supportive role in achieving effective mathematics education:

•policymakers in government, business, and industry;

•schools and school systems, including administrators and board members;

•administrators in colleges and universities;

•leaders of professional organizations.

Annotated vignettes are used to elaborate the visions of teaching, evaluation of teaching, and professional development. The narratives are meant to be like video clips to provide brief vivid glimpses into diverse settings to animate the standards. The vignettes present identifiable classroom situations that enable teachers to visualize other teachers in action and to examine a range of approaches that they might take in all aspects of their own work, from posing problems to students to analyzing their own performance. The vignettes, which display vividly the richness of mathematical learning, were gathered from actual experiences of educators with students from diverse cultural, linguistic, and socioeconomic backgrounds.

## Next Steps

Dialogue on school reform is taking place on many fronts. In local areas, individual schools, districts, and universities are approaching change in different ways and taking steps in different sequences. Various combinations of ideas and strategies will provide many alternatives to achieve the goals of reforming mathematics teaching and learning. The common characteristics will be the long-term commitment and the cooperative efforts of all teachers, administrators, parents, other educators, and policymakers. All who have responsibility for any part of the support and development of mathematics teachers and teaching are challenged to use these standards as a basis for discussion that leads to actions for making changes to meet the goal of a high-quality mathematics education for every child. As the Standards remind us: We must be impatient enough to take action, but patient enough to sustain our efforts until we see results.

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This digest was prepared with funding from the Office of Educational Research and Improvement, U.S. Department of Education, under contract number RI-88062006. The options expressed in this report do not necessarily reflect the position of policies of OERI or the Department of Education.



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